



[4910-13]

**DEPARTMENT OF TRANSPORTATION**

**Federal Aviation Administration**

**14 CFR Part 23**

[Docket No.FAA-2015-0721; Notice No. 23-269-SC]

**Special Conditions: Honda Aircraft Company, Model HA-420 HondaJet, Lithium-ion Batteries**

**AGENCY:** Federal Aviation Administration (FAA), DOT.

**ACTION:** Final special conditions.

**SUMMARY:** These special conditions are issued for the Honda Aircraft Company, Model HA-420 airplane. This airplane will have a novel or unusual design feature associated with the installation of lithium-ion (Li-ion) batteries. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. These special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

**DATES:** These special conditions are effective [INSERT DATE OF PUBLICATION IN FEDERAL REGISTER].

**FOR FURTHER INFORMATION CONTACT:** Les Lyne, Policies & Procedures Branch, ACE-114, Federal Aviation Administration, Small Airplane Directorate, Aircraft Certification Service, 901 Locust; Kansas City, Missouri 64106; telephone (816) 329-4171; facsimile (816) 329-4090.

## **SUPPLEMENTARY INFORMATION:**

### **Background**

On October 11, 2006, Honda Aircraft Company applied for a type certificate for their new Model HA-420. On October 10, 2013, Honda Aircraft Company requested an extension with an effective application date of October 1, 2013. This extension changed the type certification basis to amendment 23-62.

The HA-420 is a four to five passenger (depending on configuration), two crew, lightweight business jet with a 43,000-foot service ceiling and a maximum takeoff weight of 9963 pounds. The airplane is powered by two GE-Honda Aero Engines (GHAE) HF-120 turbofan engines.

The current regulatory requirements for part 23 airplanes do not contain adequate requirements for the application of Li-ion batteries in airborne applications. This type of battery possesses certain failure, operational characteristics, and maintenance requirements that differ significantly from that of the nickel cadmium and lead acid rechargeable batteries currently approved in other normal, utility, acrobatic, and commuter category airplanes. Therefore, the FAA is proposing this special condition to require that (1) all characteristics of the rechargeable lithium batteries and their installation that could affect safe operation of the HA-420 are addressed, and (2) appropriate Instructions for Continued Airworthiness which include maintenance requirements are established to ensure the availability of electrical power from the batteries when needed.

## **Type Certification Basis**

Under the provisions of 14 CFR § 21.17, Honda Aircraft Company must show that the HA-420 meets the applicable provisions of part 23, as amended by Amendments 23-1 through 23-62 thereto.

If the Administrator finds that the applicable airworthiness regulations (i.e., 14 CFR part 23) do not contain adequate or appropriate safety standards for the HA-420 because of a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16.

In addition to the applicable airworthiness regulations and special conditions, the HA-420 must comply with the fuel vent and exhaust emission requirements of 14 CFR part 34 and the noise certification requirements of 14 CFR part 36, and the FAA must issue a finding of regulatory adequacy under section 611 of Public Law 92-574, the "Noise Control Act of 1972."

The FAA issues special conditions, as defined in 14 CFR 11.19, in accordance with § 11.38, and they become part of the type-certification basis under § 21.17(a)(2).

Special conditions are initially applicable to the model for which they are issued. Should the type certificate for that model be amended later to include any other model that incorporates the same or similar novel or unusual design feature, the special conditions would also apply to the other model under § 21.101.

## **Novel or Unusual Design Features**

The HA-420 will incorporate the following novel or unusual design feature:  
The installation of Li-ion batteries.

The current regulatory requirements for part 23 airplanes do not contain adequate requirements for the application of Li-ion batteries in airborne applications. This type of battery

possesses certain failure, operational characteristics, and maintenance requirements that differ significantly from that of the nickel cadmium and lead acid rechargeable batteries currently approved in other normal, utility, acrobatic, and commuter category airplanes.

## **Discussion**

The applicable parts 21 and 23 airworthiness regulations governing the installation of batteries in general aviation airplanes, including § 23.1353, were derived from Civil Air Regulations (CAR 3) as part of the recodification that established 14 CFR part 23. The battery requirements, which are identified in § 23.1353, were a rewording of the CAR requirements that did not add any substantive technical requirements. An increase in incidents involving battery fires and failures that accompanied the increased use of Nickel-Cadmium (Ni-Cad) batteries in aircraft resulted in rulemaking activities on the battery requirements for transport category airplanes. These regulations were incorporated into § 23.1353(f) and (g), which apply only to Ni-Cad battery installations.

The use of Li-ion batteries on the HA-420 airplane has prompted the FAA to review the adequacy of the existing battery regulations with respect to that chemistry. As the result of this review, the FAA has determined that the existing regulations do not adequately address several failure, operational, and maintenance characteristics of Li-ion batteries that could affect safety of the battery installation of the HA-420 airplane electrical power supply.

The introduction of Li-ion batteries into aircraft raises some concern about associated battery/cell monitoring systems and how these may affect utilization of an otherwise “good” battery as an energy source to the electrical system when monitoring components fail. Associated

battery/cell monitoring systems (i.e., temperature, state of charge, etc.) should be evaluated/tested with respect the expected extremes in the aircraft operating environment.

Li-ion batteries typically have different electrical impedance characteristics than lead-acid or Ni-Cad batteries. Honda Aircraft Company needs to evaluate other components of the aircraft electrical system with respect to these characteristics.

At present, there is very limited experience regarding the use of Li-ion rechargeable batteries in applications involving commercial aviation. However, other users of this technology range from wireless telephone manufacturers to the electric vehicle industry and have noted significant safety issues regarding the use of these types of batteries, some of which are described in the following paragraphs:

1. Overcharging. In general, lithium batteries are significantly more susceptible to internal failures that can result in self-sustaining increases in temperature and pressure (i.e., thermal runaway) than their nickel-cadmium or lead-acid counterparts. This is especially true for overcharging, which causes heating and destabilization of the components of the cell, leading to the formation (by plating) of highly unstable metallic lithium. The metallic lithium can ignite, resulting in a self-sustaining fire or explosion. Finally, the severity of thermal runaway due to overcharging increases with increasing battery capacity due to the higher amount of electrolyte in large batteries.

2. Over-discharging. Discharge of some types of lithium battery cells beyond a certain voltage (typically 2.4 volts) can cause corrosion of the electrodes of the cell; resulting in loss of battery capacity that cannot be reversed by recharging. This loss of capacity may not be detected

by the simple voltage measurements commonly available to flight crews as a means of checking battery status—a problem shared with nickel-cadmium batteries.

3. Flammability of Cell Components: Unlike nickel-cadmium and lead-acid batteries, some types of lithium batteries use liquid electrolytes that are flammable. The electrolyte can serve as a source of fuel for an external fire if there is a breach of the battery container.

These safety issues experienced by users of lithium batteries raise concern about the use of these batteries in commercial aviation. The intent of the special condition is to establish appropriate airworthiness standards for lithium battery installations in the HA-420 and to ensure, as required by §§ 23.1309 and 23.601, that these battery installations are not hazardous or unreliable.

Additionally, RTCA, in a joint effort with the FAA and industry, has released RTCA/DO-311, Minimum Operational Performance Standards for Rechargeable Lithium Battery Systems, which gained much of its text directly from previous Li-ion special conditions. Honda Aircraft Company proposes to use DO-311 as the primary methodology for assuring the battery will perform its intended functions safely as installed in the HA-420 airplane and as the basis for test and qualification of the battery. This Special Condition incorporates applicable portions of DO-311.

## **Discussion**

Notice of proposed special conditions No. 23-15-03-SC for the Honda Aircraft Company, Model HA-420 airplane was published in the Federal Register on April 14, 2015 (80 FR 19889). No comments were received, and the special conditions are adopted as proposed.

## **Applicability**

As discussed above, these special conditions are applicable to the HA-420. Should Honda Aircraft Company apply at a later date for a change to the type certificate to include another model incorporating the same novel or unusual design feature, the special conditions would apply to that model as well.

Under standard practice, the effective date of final special conditions would be 30 days after the date of publication in the Federal Register; however, as the certification date for the Honda Aircraft Company HA-420 is imminent, the FAA finds that good cause exists to make these special conditions effective upon issuance.

## **Conclusion**

This action affects only certain novel or unusual design features on one model of airplanes. It is not a rule of general applicability and it affects only the applicant who applied to the FAA for approval of these features on the airplane.

## **List of Subjects in 14 CFR Part 23**

Aircraft, Aviation safety, Signs and symbols.

## **Citation**

The authority citation for these special conditions is as follows:

**Authority:** 49 U.S.C. 106(g), 40113, 44701, 44702, 44704, 14CFR 21.16 and 14 CFR 11.38 and 11.19.

## **The Special Conditions**

Accordingly, pursuant to the authority delegated to me by the Administrator, the following special conditions are issued as part of the type certification basis for Honda Aircraft Company, HA-420 airplanes.

### **1. Lithium-ion Battery Installation.**

a. Safe cell temperatures and pressures must be maintained during any probable charging or discharging condition, or during any failure of the charging or battery monitoring system not shown to be extremely remote. The applicant must design Li-ion battery installation to preclude explosion or fire in the event of those failures.

b. The applicant must design the Li-ion batteries to preclude the occurrence of self-sustaining, uncontrolled increases in temperature or pressure.

c. No explosive or toxic gasses emitted by any Li-ion battery in normal operation or as the result of any failure of the battery charging or monitoring system, or battery installation not shown to be extremely remote, may accumulate in hazardous quantities within the airplane.

d. Li-ion batteries that contain flammable fluids must comply with the flammable fluid fire protection requirements of § 23.863(a) through (d).

e. No corrosive fluids or gasses that may escape from any Li-ion battery may damage surrounding airplane structure or adjacent essential equipment.

f. The applicant must provide provision for each installed Li-ion battery to prevent any hazardous effect on structure or essential systems that may be caused by the maximum amount of heat the battery can generate during a short circuit of the battery or of its individual cells.

g. Li-ion battery installations must have—



(1) A system to control the charging rate of the battery automatically so as to prevent battery overheating or overcharging; or

(2) A battery temperature sensing and over-temperature warning system with a means for automatically disconnecting the battery from its charging source in the event of an over-temperature condition; or

(3) A battery failure sensing and warning system with a means for automatically disconnecting the battery from its charging source in the event of battery failure.

h. Any Li-ion battery installation whose function is required for safe operation of the airplane, must incorporate a monitoring and warning feature that will provide an indication to the appropriate flightcrew members whenever the capacity and State of Charge (SOC) of the batteries have fallen below levels considered acceptable for dispatch of the airplane.

i. The Instructions for Continued Airworthiness (ICA) must contain recommended manufacturers maintenance and inspection requirements to ensure that batteries, including single cells, meet a safety function level essential to the aircraft's continued airworthiness.

(1) The ICA must contain operating instructions and equipment limitations in an installation maintenance manual.

(2) The ICA must contain installation procedures and limitations in a maintenance manual, sufficient to ensure that cells or batteries, when installed according to the installation procedures, still meet safety functional levels essential to the aircraft's continued airworthiness. The limitations must identify any unique aspects of the installation.

(3) The ICA must contain corrective maintenance procedures to check battery capacity at manufacturers recommended inspection intervals.

(4) The ICA must contain scheduled servicing information to replace batteries at manufacturers recommended replacement time.

(5) The ICA must contain maintenance and inspection requirements to check visually for battery and/or charger degradation.

j. Batteries in a rotating stock (spares) that have experienced degraded charge retention capability or other damage due to prolonged storage must be functionally checked at manufacturers recommended inspection intervals.

k. The System Safety Assessment (SSA) process should address the software and complex hardware levels for the sensing, monitoring, and warning systems if these systems contain complex devices. The functional hazard assessment (FHA) for the system is required based on the intended functions described. The criticality of the specific functions will be determined by the safety assessment process for compliance with § 23.1309. Advisory Circular 23-1309-1C contains acceptable means for accomplishing this requirement. For determining the failure condition, the criticality of a function will include the mitigating factors. The failure conditions must address the loss of function and improper operations.

Issued in Kansas City, Missouri, on September 14, 2015.

Mel Johnson

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Aircraft Certification Service

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